STANDARDS (From California Standards Test and SAT II) – Standards of "Investigation and Experimentation" are all relevant but not included here	**ACTIVITY**
Nuclear Processes **CH11. Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept:** **CH11. b**. Students know the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by E = mc2) is small but significant in nuclear reactions.	• Warm Up with detectors • Dr. McMahan's lecture • ^{22}Na Activity
CH11. d. Students know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay. a. Describe the process of radioactive decay as the spontaneous breakdown of certain unstable elements (radioactive) into new elements (radioactive or not) through the spontaneous emission by the nucleus of alpha or beta particles. Explain the difference between stable and unstable isotopes b. Describe alpha, beta, and gamma particles; discuss the properties of alpha, beta, and gamma radiation; and write balanced nuclear reactions. **CH11. c**. Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.	• Dr. Mc Mahan's lecture • Detector Warm Up • Half Life Activity • XRF
CH11. e. Students know alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.	• Detector Warm Up
Students know how to calculate the amount of a radioactive substance remaining after an integral number of half-lives have passed.	• Ba-137 • Pennium half life
PH4. a. Students know waves carry energy from one place to another. **PH4. e**. Students know radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately 3 E 0^8 m/s.	• Dr. McMahan's lecture • XRF • 22Na • Half life
Earth's Place in the Universe ES1. Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time. As a basis for understanding this concept: ES1. e. **Students know the Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium.** ES1. f. Students know the evidence for the dramatic effects that asteroid impacts have had in shaping the surface of planets and their moons and in mass extinctions of life on Earth. ES2. Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time. As a basis for understanding this concept: ES2. b. Students know galaxies are made of billions of stars and comprise most of the visible mass of the universe. **ES2. c. Students know the evidence indicating that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars.** ES2. d. Students know that stars differ in their life cycles and that visual, radio, and X-ray telescopes may be used to collect data that reveal those differences.	• Dr. McMahan's lecture • XRF (maybe)
Electric and magnetic phenomena are related and have many practical applications e. Students know charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges. f. Students know magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources. i. Students know plasmas, the fourth state of matter, contain ions or free electrons or both and conduct electricity.	• Human Accelerator Warm Up • Tour of the 88-Inch Cyclotron